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Rubber products — Guidelines for storage

Produits à base d'élastomères — Lignes directrices pour le stockage

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Contents

Page

Annex

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 2230 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

This second edition cancels and replaces the first edition (ISO 2230:1973), which has been technically revised.

Annex A of this International Standard is for information only.

Introduction

Many rubber products and components are stored for long periods before being put into service, and thus it is important they are stored in conditions that minimize unwanted changes in properties. Such changes may result from degradation, in which case they may include excessive hardening, softening, cracking, crazing and other surface effects. Other changes may be caused by deformation, contamination or mechanical damage.

In preparing this revision, the requirements of different users and the multiplicity of rubber types and products have been factors of major consideration. It is recognized that some rubbers are more susceptible than others to deterioration by such factors as heat, light, ozone, oxygen and humidity. Exposure to these factors should therefore be minimized in order to extend storage life, and to do so a system of storage control, proper packaging and periodic inspection becomes necessary.

A system of recording, for the proper maintenance of storage and inspection data, is included to assist in verifying that the provisions of this standard are maintained in association with common elements associated with product specifications and their verification through conducting of statistically significant methods of test. Further guidance can be found, to supplement the information contained in this standard, in ISO 9000, ISO 9001 and ISO 9004.

In this standard, only the causes of generation of deleterious influences such as ozone and radiation are mentioned as being prohibited. Methods for measuring concentrations or intensities of these are not within the scope of this standard.

Recommendations are included in annex A for the inspection and testing of specific products.

Rubber products — Guidelines for storage

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This International Standard gives guidelines for the inspection, recording procedures, packaging and storage of products, assemblies and components made from vulcanized or thermoplastic rubber prior to being put into circulation.

It is applicable to both solid and cellular rubber products prepared from dry raw rubber, latex or other sources. It is not intended for use with raw rubber in bale, liquid (solution or emulsion) or particulate form, storage guidance for which is given in ISO 7664.

The recommendations for packaging form an integral part of the controlled storage procedure, as well as providing means of identifying the material and product.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1629:1995, *Rubber and latices — Nomenclature*

ISO 4591:1992, *Plastics — Film and sheeting — Determination of average thickness of a sample, and average thickness and yield of a roll, by gravimetric techniques (gravimetric thickness)*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
initial storage period
the maximum period, starting from the time of manufacture, for which a rubber product, appropriately packaged, may be stored under specified conditions before a sample needs to be inspected or re-tested

3.2
extension storage period
the period for which a rubber product, appropriately packaged, may be stored after the initial storage period, before further inspection and re-testing is necessary

3.3

storage life

the maximum period of time that a rubber product, appropriately packaged, may be stored, after which time it is regarded as unserviceable for the purposes for which it was originally manufactured

NOTE The storage life of a rubber product is influenced by its shape and size as well as its composition, with thick products usually undergoing slower change due to degradation than thinner ones.

3.4

assembly

any product or component containing more than one element, one or more of which is made of rubber

3.5

ageing

the irreversible change of material properties during exposure to an environment, for a period of time

4 Classification of rubber types according to their relative susceptibility to deterioration

4.1 General

Unless otherwise specified in the product specification, rubber products should be classified (for the purpose of storage) in terms of the relative susceptibility to deterioration of the rubber type used, as follows:

Group A: rubbers with moderate susceptibility to deterioration by ageing, as listed in Table 1.

The following additional rubbers are classified as group A:

— all new vulcanizable rubbers until their storage capabilities have been established;

— all thermoplastic rubbers until their storage capabilities have been established;

— any rubber that cannot be classified as group B or group C.

Group B: rubbers with low susceptibility to deterioration by ageing, as listed in Table 2.

Group C: rubbers which are highly resistant to deterioration by ageing, as listed in Table 3.

NOTE Attention is drawn to the following:

— resistance to deterioration can be influenced by compounding ingredients other than the type of base rubber;

— products can undergo changes during storage other than those caused by ageing of the rubber.

Table 1 — Group A rubbers

Abbreviation	Chemical name from ISO 1629	Common name
BR	Butadiene rubber	Polybutadiene
NR	Isoprene rubber, natural	Natural rubber
IR	Isoprene rubber, synthetic	Polyisoprene
SBR	Styrene-butadiene rubber	SBR
AU	Polyester urethane rubber	Polyurethane
EU	Polyether urethane rubber	Polyurethane

Table 2 — Group B rubbers

Abbreviation	Chemical name from ISO 1629	Common name
NBR	Acrylonitrile-butadiene rubber	Nitrile
NBR/PVC	Blend of acrylonitrile-butadiene rubber and poly(vinyl chloride)	Nitrile/PVC
XNBR	Carboxylic-acrylonitrile-butadiene rubber	Carboxylated rubber
HNBR	Hydrogenated NBR (with some unsaturation)	Hydrogenated nitrile
CO, ECO	Polychloromethyloxiran and copolymer	Epichlorohydrin
ACM	Copolymer of ethylacrylate (or other acrylates) and a small amount of a monomer which facilitates vulcanization	Acrylic
CR	Chloroprene rubber	Neoprene
IIR	Isobutene-isoprene rubber	Butyl
BIIR	Bromo-isobutene-isoprene rubber	Bromobutyl
CIIR	Chloro-isobutene-isoprene rubber	Chlorobutyl

Table 3 — Group C rubbers

Abbreviation	Chemical name from ISO 1629	Common name
CM	Chloropolyethylene	Chlorinated polyethylene
CSM	Chlorosulfonylpolyethylene	Chlorosulfonated polyethylene
EPM	Ethylene-propylene copolymer	EPM, EPR
EPDM	Terpolymer of ethylene, propylene and a diene with the residual unsaturated portion of the diene in the side chain	EPDM
FKM	Rubber having fluoro, perfluoroalkyl or perfluoroalkoxy substituent groups on the polymer chain	Fluorocarbon
Q	Silicone rubber	Silicone
FMQ	Silicone rubber having both methyl and fluorine substituent groups on the polymer chain	
PMQ	Silicone rubber having both methyl and phenyl substituent groups on the polymer chain	
PVMQ	Silicone rubber having methyl, phenyl and vinyl substituent groups on the polymer chain	
MQ	Silicone rubber having only methyl substituent groups on the polymer chain, such as dimethyl polysiloxane	
VMQ	Silicone rubber having both methyl and vinyl substituent groups on the polymer chain	

4.2 Blends and composites

A blend of two or more rubbers of different groups should be classified as the group of the rubber(s) forming more than 50 % of the blend. If two rubbers are in equal proportions, the blend belongs to the group having the higher susceptibility to deterioration. For a composite product containing components made out of different rubbers, classification should be as the group of the rubber considered most susceptible to deterioration.

5 Packaging

5.1 General

Unless otherwise specified in the appropriate product specification, rubber products should be:

— enclosed in individual sealed envelopes;

or

— enclosed in individual sealed pockets in a multiple envelope provided that they can be removed without affecting the sealing of the remainder of the items in the package;

or

— if it is not possible to package the items in either of these ways, suitably enclosed or wrapped so as to prevent free access of air.

NOTE 1 Under certain conditions silicone rubber (Q) deteriorates if totally enclosed and in these cases free access of air is advisable provided other deteriorating agencies (see 6.2) are avoided.

NOTE 2 It is advisable that packaging be completed as soon as is reasonably practicable after curing in the case of a vulcanized rubber product, or as soon as reasonably practicable after manufacture in the case of a thermoplastic rubber product.

The packaging should be carried out in an atmosphere in which the relative humidity is not greater than 65 % (see 6.2.2) and under conditions that will ensure freedom from contamination by dust, oil, grease, etc.

If it is necessary for rubber components to be packed in assembly sets, the components should be retained in their original identifying envelopes within the main package.

No part should be tied or tagged in such a way as to cause damage.

5.2 Packaging materials

All material of any containers, covering or wrapping should be free from substances, such as copper naphthenates or creosote preservatives, having a degrading effect on the rubber.

Heat-sealable opaque materials should be used unless it can be demonstrated that this is not practicable in the circumstances or would distort the packaged product.

NOTE 1 Some suitable materials are polyethylene-coated kraft paper, aluminium foil/paper/polyethylene laminate and opaque polyethylene film.

Plasticized poly(vinyl chloride) (PVC) film, or any other film containing plasticizer, should not be used in direct contact with the rubber. If for any reason a transparent or translucent material is used, it should be over-wrapped with an opaque material.

If polyethylene is used as a single wrapping, it should be not less than 0,075 mm thick (determined in accordance with ISO 4591).

NOTE 2 For some products, antistatic plastics wrapping may be required.

Where there is serious risk of ingress of moisture (see 6.2.2), aluminium foil/paper/polyethylene laminate or other similar means of protection should be used to ensure protection from ingress of moisture.

5.3 Labelling

Every package or container should be labelled with the following information which should be visible from the outside of the package without breaking the seal:

a) the manufacturer's part number;

b) the specification number of the product or component (where applicable) and/or the polymer description;

c) the quarter and year of vulcanization or manufacture of the rubber product or component (e.g. July to September 1994 = 3/94);

d) the classification of the rubber type in accordance with clause 4;

e) the quantity in the package;

f) the manufacturer's identification or trade mark;

g) the manufacturer's batch number or similar means of production identification.

6 Storage

6.1 General (see also the Introduction)

Materials, unassembled components and assemblies containing rubber components packaged in accordance with clause 5 should be stored indoors under the conditions given in 6.2.

NOTE It is advisable that the physical environment in which rubber is stored is given due consideration, as thermoplastics tiles and painted surfaces may become permanently stained through migration or volatilization of compounding ingredients such as antidegradants or process oil.

6.2 Storage conditions

6.2.1 Temperature

The storage temperature should be below 25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below 15 °C, care should be exercised during the handling of stored products as they may have stiffened and become susceptible to distortion if not handled carefully. The temperature of products taken from such low-temperature storage should be raised to approximately 30 °C throughout their mass, before the products are put into service.

6.2.2 Humidity

The relative humidity should be such that, given the variations of temperature in storage, condensation does not occur. In any event, the relative humidity of the atmosphere in storage should be less than 70 % or, if polyurethanes are being stored, less than 65 %.

NOTE

— Air with 75 % RH at 15 °C will have a dew point of approximately 11 °C.

— Air with 75 % RH at 20 °C will have a dew point of approximately 16 °C.

— Air with 65 % RH at 15 °C will have a dew point of approximately 9 °C.

— Air with 65 % RH at 20 °C will have a dew point of approximately 13 °C.

— Air with 50 % RH at 10 °C will have a dew point of approximately 0 °C.

6.2.3 Light

Rubber should be protected from light sources, in particular direct sunlight or intense artificial light having a high ultra-violet content.

NOTE It is advisable that any windows of storage rooms be covered with a red or orange coating or screen.

6.2.4 Radiation

Precautions should be taken to protect stored products from all sources of ionizing radiation likely to cause damage to the products.

6.2.5 Ozone

As ozone is particularly deleterious to rubber, storage rooms should not contain any equipment that is capable of generating ozone, such as mercury vapour lamps or high-voltage electrical equipment giving rise to electric sparks or silent electrical discharges. Combustion gases and organic vapours should be excluded from storage rooms, as they may give rise to ozone via photochemical processes.

NOTE 1 When equipment such as a fork-lift truck is used to handle large rubber products, care needs to be taken to ensure this equipment is not a source of pollution that may affect the rubber.

NOTE 2 Combustion gases should be considered separately. While they are responsible for generating ground-level ozone, they may also contain unburned fuel which, by condensing on rubber products, can cause additional deterioration.

6.2.6 Deformation

Rubber should be stored free from superimposed tensions and compressive stresses or other causes of deformation. Where products are packaged in a strain-free condition, they should be stored in their original packaging. In case of doubt, the manufacturer's advice should be sought.

NOTE It is advisable that rings of large internal diameter are formed into three equal superimposed loops so as to avoid creasing or twisting. It is not possible to achieve this condition by forming just two loops.

6.2.7 Contact with liquid and semi-liquid materials

Rubber should not be allowed to come into contact with liquid or semi-liquid materials (for example, petrol, greases, acids, disinfectants, cleaning fluids) or their vapours at any time during storage, unless these materials are by design an integral part of the product or the manufacturer's packaging. When rubber products are received coated with their operational media, they should be stored in this condition.

6.2.8 Contact with metals

Certain metals and their alloys (in particular, copper and manganese) are known to have deleterious effects on some rubbers. Rubber should not be stored in contact with such metals except when bonded to them but should be protected by wrapping in or by separation with a layer of suitable material, e.g. paper or polyethylene, as specified in clause 5.

6.2.9 Contact with dusting powder

Dusting powders should only be used for the packaging of rubber items in order to prevent blocking (see ISO 5978). In such instances, the minimum quantity of powder to prevent adhesion should be used.

Any powder used should be free from any constituent having a deleterious effect on the rubber or the subsequent application of the rubber.

6.2.10 Contact between different products

Contact between products made from rubbers of different compositions should be avoided. This includes products differing only in colour.

6.2.11 Products with rubber-to-metal bonds

The metal part of rubber-to-metal bonded products should not come into contact with the rubber of other products. Any preservative used on the metal should be such that it will not adversely affect the rubber or the bond to such an extent that it does not comply with the product specification.

6.2.12 Proofed fabrics and rubber sheeting

Proofed fabrics and rubber sheeting less than approximately 1 m^2 in area or less than approximately 2 m in length should be stored flat, ideally with the layers interleaved with a suitable material as specified in 5.2. Larger areas and longer lengths of material should be rolled, with the layers interleaved with a suitable material as specified in 5.2.

6.2.13 Rotation of stocks

Products should be issued from stores in strict rotation so that the products remaining in store are those of most recent manufacture or delivery.

7 Inspection, testing and recording of data during storage

7.1 Recording

A record should be kept of the test characteristics of items stored. Such records should include an indication of the acceptable confidence interval of the mean for each parameter tested where the test conducted provides a numerical result.

NOTE In this regard, reference to ISO 2602 and ISO 3207 is advised.

A record should also be kept of the following:

— the quantity of each item stored, the date of initial packaging, and the date it was put into store;

— the date of any subsequent repackaging (see 7.4);

— the manufacturer's batch number [see 5.3 g)];

— the quantity of items that are a representative sample of those items.

7.2 Inspection

7.2.1 Inspection before extension storage

Before any items are to be stored for any extension storage period (see 7.3.2), representative samples of each type should be selected for inspection at the end of the appropriate initial storage period. Items should not be laid on concrete floors or other rough surfaces or in areas susceptible to contamination by grit.

Inspection should be in accordance with the relevant product specification or, where the relevant specification does not make such provision, the minimum visual inspection procedures in 7.2.2 should apply.

7.2.2 Visual inspection

Inspect each of the items in the representative sample for the following:

— permanent distortions, such as creases or flats;

— mechanical damage, such as cuts, tears, abraded areas or delaminated plies;

— surface cracking when viewed under a magnification of × 10;

— changes in surface condition, such as hardening, softening or tackiness.

7.2.3 Testing

Providing that, when inspected in accordance with 7.2.1 or 7.2.2 they are found satisfactory in respect of 7.2.2, items should be tested to ascertain that their relevant performance characteristics are within the acceptable confidence limits recorded in 7.1.

Testing to demonstrate that the product is serviceable should be carried out in accordance with the appropriate product specification for the particular item concerned.

7.3 Storage periods

7.3.1 Assessment at the end of the initial period

If, following the visual inspection procedure in 7.2.1 or 7.2.2 or following the test procedures in 7.2.3, the items are not satisfactory, they should not be released into any extension storage period (see 7.3.2). If the items are satisfactory and are placed into an extension storage period, the provisions of 7.1 should apply and, in addition, a record should be kept of the date of commencement of the initial storage as well as the date of commencement of the extension storage period.

7.3.2 Extension storage period

Items admitted into an extension storage period (see Table 4) should be inspected and tested in accordance with 7.2.1 and 7.2.3 at or before the expiry of the extension storage period before they are put into service or admitted to any further extension storage period.

The duration of the storage periods, both initial and extension, will normally be specified in the appropriate specification.

7.3.3 Duration of storage

Unless otherwise specified in the product specification, the initial storage period and extension storage periods should be those given in Table 4.

NOTE 1 The initial storage periods and extension storage periods for rubber types classified according to the groups defined in clause 4 are tabulated in Table 4. It is pointed out that these periods apply to unassembled rubber components packaged and stored in accordance with the recommendations of clause 5 and clause 6.

NOTE 2 Storage periods shorter than those tabulated in Table 4 may be advisable for some group A rubber products of less than 1,5 mm thickness and for group A cellular rubbers (as well as for items packaged and/or stored under conditions other than those given in clause 5 and clause 6).

Table 4 — Initial and extension storage periods for unassembled components

Classification of group	Initial storage period (see 3.1 and clause 7)	Extension storage periods (see 3.2 and clause 7)
Group A rubbers	5 years	2 years
Group B rubbers	7 years	3 years
Group C rubbers	10 years	5 years
NOTE If the storage temperature is over or under 25 °C, this will influence the storage time. Storage at a 10 °C higher temperature will reduce the storage time by about 50 % and storage at a 10 °C lower temperature will increase the storage time by about 100 %.		

7.4 Repackaging

If products are removed from storage for inspection or testing or any other purpose and are subsequently to be returned to storage for a further period, they should be repackaged in accordance with clause 5 and the date of repackaging recorded on the container.

Annex A
(informative)

Recommendations for inspection and testing of specific products

A.1 General

The following International Standards provide requirements or information on the storage of specific items:

ISO 1825:1996

ISO 4223-2:1991

ISO 5285:1978

ISO 8331:1991

For details of these and other relevant International Standards, see the Bibliography.

A.2 Flexible tanks and containers

Flexible tanks and containers should be inspected in accordance with 7.2 by laying out flat on clean cellular-rubber sheeting or another suitable surface.

A.3 Inflatable products

Inflatable products including dinghies should be inspected in accordance with 7.2 and should be subjected to any pressure maintenance test stipulated in the relevant specification.

A.4 Seals, extrusions and large products

Seals, extrusions and large products should be inspected in accordance with 7.2. Special attention should be given to the condition of the lip or sealing surface of seals and the edges of extrusions and components.

A.5 Braided rubber cords

Braided rubber cords should be visually inspected for damage to the braid and the mechanical properties of the finished cords determined in accordance with the relevant specification. A sample cord should be stripped of braid and the rubber strands inspected in accordance with 7.2.

A.6 Rubber-to-metal bonded components

A.6.1 The rubber parts of rubber-to-metal bonded components should be inspected in accordance with 7.2.

A.6.2 The edge of the bond should be inspected where this is practicable, the inspection being carried out with the rubber in slight tension.

A.7 Proofed fabrics and rubber sheeting

Proofed fabrics and rubber sheeting should be inspected in accordance with 7.2. Special attention should be given to regions where folding may have been necessary for storage. The material should be inspected by laying out flat on clean cellular-rubber sheeting or another smooth surface free from grit or other contamination.

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[2] ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

[3] ISO 3207:1975, *Statistical interpretation of data — Determination of a statistical tolerance interval*

[4] ISO 4223-2:1991, *Definitions of some terms used in the tyre industry — Part 2: Solid tyres*

[5] ISO 5285:1978, *Conveyor belts — Guide to storage and handling*

[6] ISO 5978:1990, *Rubber- or plastics-coated fabrics — Determination of blocking resistance*

[7] ISO 7664:2000, *Rubber, raw natural and raw synthetic — General guidance on storage*

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